Small Business Innovation Research/Small Business Tech Transfer

Pneumatic Excavation Mechanism for Lunar Resource Utilization, Phase I

Completed Technology Project (2007 - 2007)

Project Introduction

As part of the NASA goal of "locating and characterizing lunar volatile resources", Honeybee Robotics proposes to investigate two novel technologies that both are powered by a new monopropellant, NOFB3, developed by Firestar Engineering. Honeybee will test key concepts for a pneumatic drill, intended for use in the lunar cold traps, and will also investigate a method for mining the top few centimeters of lunar regolith with a gas system that has no moving parts. Analogous to the high-powered drilling done on Earth, the proposed pneumatic drill will derive its mechanical power from a chemical fuel (NOFB3), and it will use a fluid (in this case, low temperature exhaust gases extracted from the power system) to remove drill cuttings. A drill of this sort will have a number of advantages over traditional electromechanical drill/auger systems, including reduced power consumption, lower mass, less mechanical complexity, and better durability at extreme temperatures. In Phase I, the team proposes to investigate the production of mechanical power from the monopropellant via a small turbine, and, separately, to study removal of cuttings with gas flow while drilling in a laboratory vacuum chamber. The second part of the proposed research will be to investigate a method for mining the top few centimeters of lunar regolith using a method similar to "jet-lift dredging". This method will use a stream of gas, also provided by the partial decomposition of NOFB3, to draw simulated lunar regolith into a delivery pipe connected to a storage bin. The system has no moving parts and is thus well suited for the abrasive lunar environment. The proposed coupled propulsion/pneumatic system for excavation and prospecting will enable robust, rapid, subsurface access into an in-situ medium, and particularly into permanently shadowed regions on the moon without requiring solar illumination, potentially large nuclear power systems, or potentially complicated distributed power systems.

Anticipated Benefits

Potential NASA Commercial Applications: The turbine-powered pneumatic drill system could be useful for terrestrial drilling in Polar Regions, where gasoline engines perform poorly at very cold temperatures. The basic system for generating power via a small turbine could also be adapted to other mechanical devices, such as pumps or winches. The monopropellant pressurant system (see previous section) could also be used by the commercial launch industry. In the distant future, on the order of several decades, the gas flow mining method investigated in this project could evolve into a commercial system for lunar or asteroid mining.

Pneumatic Excavation Mechanism for Lunar Resource Utilization, Phase I

Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

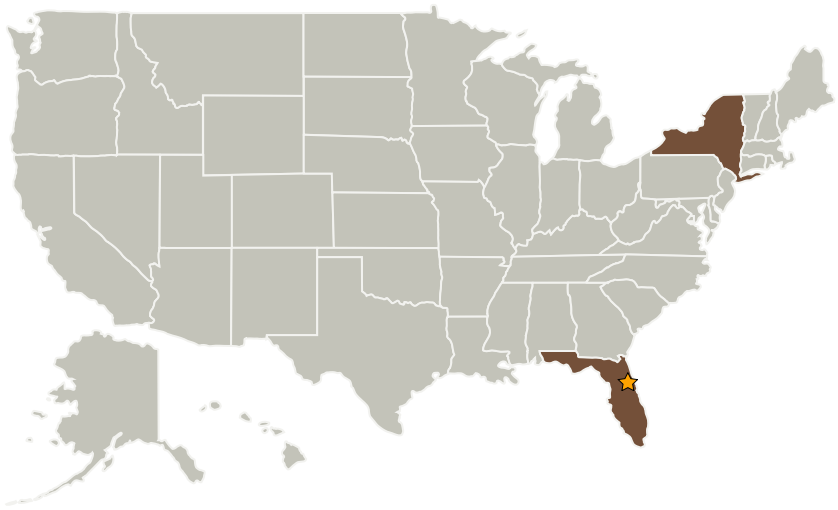
Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Pneumatic Excavation Mechanism for Lunar Resource Utilization, Phase I

Completed Technology Project (2007 - 2007)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
Honeybee Robotics, Ltd.	Supporting Organization	Industry	Pasadena, California

Primary U.S. Work Locations	
Florida	New York

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Kris Zacny

Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.2 Resource Acquisition, Isolation, and Preparation